

## ENT COOPERATION TREA

From the INTERNATIONAL BUREAU

**PCT****NOTIFICATION OF ELECTION**

(PCT Rule 61.2)

<b>Date of mailing (day/month/year)</b> 29 March 1999 (29.03.99)	<b>To:</b>  United States Patent and Trademark Office (Box PCT) Crystal Plaza 2 Washington, DC 20231 ÉTATS-UNIS D'AMÉRIQUE  in its capacity as elected Office
<b>International application No.</b> PCT/DK98/00342	<b>Applicant's or agent's file reference</b>
<b>International filing date (day/month/year)</b> 06 August 1998 (06.08.98)	<b>Priority date (day/month/year)</b> 06 August 1997 (06.08.97)
<b>Applicant</b> MATHIESEN, Benny, Martin	

1. The designated Office is hereby notified of its election made:

in the demand filed with the International Preliminary Examining Authority on:

18 February 1999 (18.02.99)

in a notice effecting later election filed with the International Bureau on:

\_\_\_\_\_

2. The election  was

was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland  Facsimile No.: (41-22) 740.14.35	Authorized officer  Nicola Wolff  Telephone No.: (41-22) 338.83.38
---	--

## PENT COOPERATION TREA

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING  
OF A CHANGE(PCT Rule 92bis.1 and  
Administrative Instructions, Section 422)

To:	
<b>PATENTGRUPPEN APS</b> Arosgaarden Aaboulevarden 31 DK-8000 Aarhus C DANEMARK	

Date of mailing (day/month/year) 29 March 1999 (29.03.99)	
Applicant's or agent's file reference	<b>IMPORTANT NOTIFICATION</b>
International application No. PCT/DK98/00342	International filing date (day/month/year) 06 August 1998 (06.08.98)

## 1. The following indications appeared on record concerning:

the applicant     the inventor     the agent     the common representative

Name and Address  MATHIESEN, Benny, Martin KE-Burgmann a/s Expansion Joints Division Parkallé 34 DK-6600 Vejen Denmark	State of Nationality	State of Residence
	Telephone No. +45 7536 1811	
	Facsimile No. +45 7536 1532	
	Teleprinter No.	

## 2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

the person     the name     the address     the nationality     the residence

Name and Address  PATENTGRUPPEN APS Arosgaarden Aaboulevarden 31 DK-8000 Aarhus C Denmark	State of Nationality	State of Residence
	Telephone No. +45 86 19 20 00	
	Facsimile No. +45 86 19 91 91	
	Teleprinter No.	

## 3. Further observations, if necessary:

## 4. A copy of this notification has been sent to:

<input checked="" type="checkbox"/> the receiving Office	<input type="checkbox"/> the designated Offices concerned
<input type="checkbox"/> the International Searching Authority	<input checked="" type="checkbox"/> the elected Offices concerned
<input checked="" type="checkbox"/> the International Preliminary Examining Authority	<input checked="" type="checkbox"/> other: MATHIESEN, Benny, Martin

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland  Facsimile No.: (41-22) 740.14.35	Authorized officer  Nicola Wolff  Telephone No.: (41-22) 338.83.38
---	--

From the  
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

PATENTGRUPPEN A/S  
Arosgaarden  
Aaboulevarden 31  
DK-8000 Aarhus C  
DANEMARK

PCT

NOTIFICATION OF TRANSMITTAL OF  
THE INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT  
(PCT Rule 71.1)

Date of mailing  
(day/month/year)

27.11.99

Applicant's or agent's file reference  
P 98 002 WO

IMPORTANT NOTIFICATION

International application No.  
PCT/DK98/00342

International filing date (day/month/year)  
08/08/1998

Priority date (day/month/year)  
08/08/1997

Applicant  
KE-BURGMANN A/S et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/I/B/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/

European Patent Office  
D-80298 Munich  
Tel. +49 89 2399 - 0 Tx: 623658 epmu d  
Fax: +49 89 2399 - 4485

Authorized officer

Ridé, M-C

Tel. +49 89 2399-5082

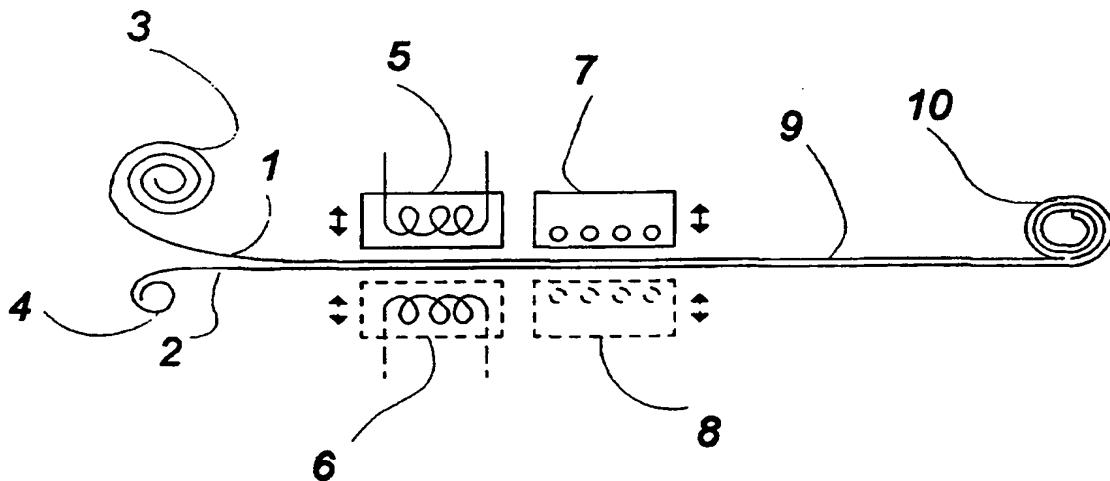




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> : <b>B32B 27/12, 31/08, B29C 65/44</b>	A1	(11) International Publication Number: <b>WO 99/07551</b> (43) International Publication Date: 18 February 1999 (18.02.99)
<p>(21) International Application Number: PCT/DK98/00342</p> <p>(22) International Filing Date: 6 August 1998 (06.08.98)</p> <p>(30) Priority Data: 0910/97 6 August 1997 (06.08.97) DK</p> <p>(71) Applicant (for all designated States except US): KE-BURGMANN A/S [DK/DK]; Expansion Joints Division, Parkallé 34, DK-6600 Vejen (DK).</p> <p>(72) Inventor; and</p> <p>(75) Inventor/Applicant (for US only): MATHIESEN, Benny, Martin [DK/DK]; Gl. Strandvej 1, DK-5500 Middelfart (DK).</p> <p>(74) Common Representative: MATHIESEN, Benny, Martin; KE-Burgmann a/s, Expansion Joints Division, Parkallé 34, DK-6600 Vejen (DK).</p>		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, ES, FI, FI (Utility model), GB, GE, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
<p><b>Published</b>  <i>With international search report. In English translation (filed in Danish).</i> </p>		

(54) Title: METHOD OF MANUFACTURING A COMPOSITE MATERIAL



## (57) Abstract

The invention relates to a method of manufacture of a composite product comprising at least one layer of reinforced woven material and at least one layer of PTFE foil or ePTFE foil, where the foil or foils are laminated together with the layer or layers of woven material under the use of heating and pressurising, where the composite material subsequently is cooled to a fully or partly fixed state. According to a preferred embodiment the composite is fixated by means of one or two co-operating pressure surfaces under a relative high pressure. By the invention a form stable composite material having a considerably enhanced E-module is achieved.

**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

Method of manufacturing a composite material

**Background art**

The invention relates to a method of manufacture of a  
5 composite material according to the introductory part of  
claim 1, a composite product according to the  
introductory part of claim 9 and an apparatus for  
performing the method according to the introductory part  
of claim 11.

10

Composite products comprising a reinforcing woven  
material and a PTFE foil are used for many different  
industrial purposes. Within the chemical industry, this  
kind of material is for example used for vessels,  
15 compensators, containers, conveyor belts and chemical  
barriers in general that must be able to resist strong  
chemical and thermal impacts. This is likewise the case  
within power plants, the food industry and many other  
applications where reliable and strong mechanical and/or  
20 chemical properties are also important.

In a composite material of the above kind the interaction  
between materials in the composite will create the  
properties that makes the composite material suitable for  
25 a given application. Typically, the woven material will  
improve the mechanical properties during a thermal impact  
whilst the applied PTFE foil or foils will constitute  
barrier properties that can be maintained even under high  
temperatures.

30

However, it has proven difficult to obtain a proper  
"balance" between the individual components of the  
composite material during its manufacture. This is

because a composite product typically shrinks relatively much during the manufacturing, so that the final end composite product displays significantly different dimensions than those of the original laminated product.

5 This is in particular a problem in relation to the manufacture of composite products with pre-determined end dimensions, just as there is a tendency for the composite product to bend or wrinkle particularly in the edge regions.

10

Apart from the problem in itself that the composite shrinks or in other ways are disfigured, it is also a problem that it can be difficult to predict which dimensions the end product actually obtains. This results 15 often in that the composite product, where it is possible, must be machined further after the lamination. This further treatment such as machining results in material waste just as it most often is not possible to carry out the further treatment of a product in an 20 automated manner.

Furthermore, it must be mentioned that the material waste as a result of the shrinkage of the material in itself is so high that it is a significant factor in the final 25 production price. An laminated assembly to composite product of the above kind can shrink with more than 10 %.

A way of improving the manufacturing process is by adding to the woven material an extra layer of coating on the 30 opposite side of the provided lamination of PTFE foils.

This solution however makes the manufacturing process more expensive in itself, results in an increased use of

material, and finally results in that the finished composite materials are increased in thickness and weight.

5 Disclosure for the invention

By, as disclosed in claim 1, to cool the composite material subsequently to a fully or partly fixed state, a composite material with an improved form stability, reduced shrinkage and an enhanced E-module is obtained.

10

By reducing the shrinkage for the PTFE of the composite, a better form stability for the product as a whole is hereby obtained, since the woven material typically is very sensitive to shrinkage by lamination with a foil.

15

The main purpose, that is to obtain an improved form stability, is thus a very important factor in connection to a precision produce of composite products, conduit linings, compensators, conveyor belts, tank liners, 20 containers or similar applications, where a poor form stability results in that the finished product shrinks with a relative large and not fully determined percentage.

25 This is also the case where the composite materials, in for instance chemical plants, is combined with form stabile components with known dimensions, since it can be tremendously difficult to predict the dimensions of the finished composite product.

30

A fixation of the composite could as an example be carried out by expanding the composite in a frame, and then carry out a cooling by the use of a gas or a liquid.

By the invention it is preferred to let the cooling take place as quickly as possible after the heating.

5 By a reinforcing woven material is understood for instance glass fibre fabric, PTFE fabric, PTFE coated glass fibre fabric or other materials. However it is preferred in many applications to use glass fibre fabric. By a ePTFE foil is meant an expanded PTFE foil.

10

According to the invention, by fixation in full or partly of the composite during the cooling, it is further possible to regulate or control the shrinkage of the finished product. This is of major importance in relation 15 to products where high dimensional requirements are requested of the end product. A part of the cooling process can for instance be carried out in a fixed state, whilst another part of the cooling process can be carried out in a non-fixed state.

20

It is understood that the invention can be carried out as a sub-process of a total process, since it is possible to manufacture a composite material with one added layer of foil and fabric at the time, so that a multi-layered 25 composite material can be manufactured by laminating one layer to the composite at the time.

Besides there is achieved the significant advantage that the finished composite material according to the 30 invention in itself exhibits a significantly reduced shrinkage of the end product relative to the added foils and fabrics, which means that the utilisation degree can be enhanced by at least 10 %.

Moreover, a major trimming of the edge regions can be avoided, whereby the waste of material in this relation is reduced.

5

By, as described in claim 2, to let the cooling be carried out over a period of time of approximately 0.1 to 240 seconds from a temperature of 300 to 420 °C to a temperature of about 50 °C, an advantageous and practical 10 embodiment of the invention is achieved.

It is preferred for many of the used material thickness that the time period is approximately 20 to 120 seconds from a temperature of 380 to 400 °C to a temperature of 15 about 50 °C.

It is understood that the time and cooling process is very dependent on the thickness and the properties of the individual components.

20

It should be emphasised that the cooling can be done rather quickly, whereby the combined cooling and fixation is very attractive in connection with automatic and continuous manufacturing processes.

25

It is further understood that improved results can be achieved by performing a cooling according to the invention over a part of a temperature interval, just as it is understood that the best result, however, first 30 will be achieved when cooling over the whole temperature interval, i.e. from a given high temperature to a wanted end temperature.

By, as described in claim 3, to let the composite material be subject to a tension during the cooling, an advantageous embodiment of the invention is achieved.

- 5 By, as described in claim 4, that the composite material undergoes a combined cooling and pressure operation by means for pressure application, an advantageous embodiment of the invention is achieved, since the means for pressure supply fixates the composite material during
- 10 the cooling, which results in a solid improvement of the form stability. Specifically, a particularly high E-module can be achieved for the final composite product, just as a good form stability is achievable. This means for instance that the shrinkage of a composite material
- 15 manufactured according to the invention will be significantly reduced. By certain types of products the shrinkage can be reduced with a factor 10-15 and the E-module can be enhanced by a factor 5.
- 20 The achieved fixation by means for pressure supply also means that the composite can be cooled during a very high pressure, as the composite hereby is fixated in a controlled manner during the entire cooling. This high cooling pressure results firstly in that the form of the
- 25 composite is maintained during the cooling in its final shape, and secondly that the cooling takes place much more quickly across the surface. An improved contact between the means for pressure supply and the composite thus leads to an improved mutual heat transport, whereby
- 30 the cooling of the composite can be accelerated.

By, as described in claim 5, that the means for pressure supply is provided with cooling means, a particularly

advantageous embodiment of the invention is achieved, since it has been discovered that this combined cooling and pressure application results in an optimal result with respect to the produced composite materials.

- 5 Firstly, a product with improved shrinkage properties is achieved, secondly, the product can be produced with a relative uncomplicated control.

As mentioned above, an improved contact between the means  
10 for pressure supply and the composite thus results in an improved mutual heat transfer whereby the cooling of the composite can be accelerated.

By, as described in claim 6, that the pressure supply is  
15 provided continuously by means for pressure supply comprising at least one roller, there is established a commercially advantageous possibility of providing a continuous production of a form stabile composite material and/or a high E-module.

20

The production can further be carried out in a relative high speed.

By, as described in claim 7, that the pressure supply is  
25 provided intermittently by means for pressure supply comprising a pressure surface, there is achieved a particular advantageous embodiment of the invention, as the pressure supply applied by a pressure plate can be completely controlled in the sense that any supplementary  
30 tension in the foils or the surface direction of the composite in many applications can be totally avoided.

The pressure supply can be provided by controlling only one parameter, i.e. the pressure provided by the means for pressure supply. By using this pressure surface it is avoided that the diffusion properties are influenced  
5 uncontrollably by simultaneous tension in the foils or the composite.

As a pressure surface is in this connection for instance understood a plate, just as a pressure surface can be in  
10 the shape of a form.

It is preferred according to the invention to use a relative high surface pressure, since the fixation thereby becomes better during the cooling. As an example  
15 a pressure of 0.1 - 20 N/mm<sup>2</sup> can be used.

A high surface pressure on the composite material during the cooling will result in improved material properties both with respect to the form stability and performance,  
20 just as shrinkage in the flow direction in the continuous process is reduced, as the composite due to the use of a pressure plate also is held in its longitudinal direction during the cooling.

25 By, as described in claim 8, that the composite material is cooled under a substantively uniform pressure over the surface by a cooling surface, a possibility is achieved to obtain a composite material having uniform shrinkage properties over the entire surface.

30

By, as described in claim 9, that the product comprises at least one foil layer of PTFE or ePTFE foil and at least one layer of reinforcing woven material, a product

is achieved possessing a high E-module and other advantageous material properties.

A further advantage by a composite product of the above mentioned kind is that the edge properties become improved considerably, as a reduced shrinkage of in particular materials that consist of for instance a layer of PTFE foil laminated without the use of the teaching according to the invention would have a tendency to curl or "wrinkle" in the edges of the composite product. This disadvantage is partly equalised by the improvement of the shrinkage properties, that is less shrinkage, just as the fixation of the composite during the cooling improves the resulting form stability overall in the product - and thereby also in the edge sections.

By, as described in claim 10, that the reinforcing woven material consists at least partly of glass fibre fabric or PTFE coated glass fibre fabric, a particular advantageous embodiment of the invention is achieved. The invention has proven itself particular advantageous with respect to the relative high sensibility compared with a laminated PTFE foil. It has proven possible to produce composite products, e.g. discrete components, endless webs of the composite etc., without that the dimensions of the final products divert substantively from the original form of the composite in its non-final state.

Under all circumstances it is possible according to the invention to obtain a larger degree of predictability with respect to the shrinkage.

**The drawings**

In the following, the invention is further described under reference to the drawings, where

5 fig. 1 shows a preferred embodiment of the invention, and where

fig. 2 shows a further embodiment of the invention.

10 **Preferred embodiment**

In figure 1 a schematic view is shown of a preferred automated embodiment according to the invention.

15 In the viewed embodiment, the shown apparatus is fed by endless webs of PTFE foil 1 and PTFE coated glass fibre fabric 2 from a roll of PTFE foil 3 and a roll of PTFE coated glass fibre fabric 4. The finished composite 9 is wound up on a roll 10.

20 According to the viewed embodiment the webs 1 and 2 perform a relative movement relative to the apparatus and the rollers 3, 4 and 10 are rotated by not shown forwarding means in an intermittent movement in between two co-operating heated pressure surfaces 5 and 6. These 25 pressure surfaces 5, 6 are in the shown embodiment connected to not shown hydraulic pressure- and movement means and adapted to perform a relative movement to and from the two webs 1 and 2.

30 The above stepwise movement in the longitudinal direction essentially corresponds to the pressure surfaces 5, 6.

When the stepwise movement has fed two new partial lengths of foil 1 and glass fabric 2 in between the pressure surfaces 5, 6, the pressure plates 5, 6 will move against the webs and perform a combined pressure and 5 heat treatment so that the foil 1 and the glass fabric is joined together in a lamination.

According to the viewed embodiment, the foil and the glass fabric is heated to a temperature of approx. 380°C  
10 - 400°C under a pressure of 0.1-20 N/mm<sup>2</sup>.

When the lamination is completed the pressure surfaces 5, 6 are moved away from each other and the now laminated composite is moved in an intermittent movement in between 15 two co-operating cooling means.

The cooling means will over a time period of 20 - 120 seconds cool the composite to a temperature of about 50°C and applying a pressure of 0.1 - 20 N/mm<sup>2</sup>.  
20

When the lamination of the partial length is completed the pressure surfaces are moved apart and the composite web is rolled up on a roll.

25 It is understood that the above described process is a continuous process where a cooling of a partial length is carried out simultaneous with the heating of the preceding partial length.

30 It is moreover understood that the different process parameters can be adjusted and optimised to the properties and thickness of the chosen materials.

It is thus within the scope of the invention to vary the temperature and the time intervals with respect to the applied materials and the wanted result.

- 5 It is likewise understood that the composite also could be applied a multiple of lamination and glass fibre fabric layers until the wanted thickness and the wanted material properties are achieved.
- 10 In fig. 2 a further embodiment of the invention is shown.

In the shown embodiment the apparatus is fed by endless webs of PTFE foil 1 and a PTFE coated glass fibre fabric 2 from a roll of PTFE foil 3 and a roll of PTFE coated 15 glass fibre fabric 4. The finished composite 9 is wound up on a roll 10.

According to the shown embodiment the webs 1 and 2 perform a relative movement relative to the apparatus and 20 the rollers 3, 4 and 10, that are rotated by means of not shown forwarding means in a continuous movement in between two co-operating heated pressure surfaces in the shape of rollers 15 and 16. These rollers 15, 16 are in the viewed embodiment connected to not shown pressure 25 means.

When the continuous movement has fed the two new partial lengths of the foil 1 and the glass fabric 2 in between the pressure rollers 15, 16, the pressure rollers are 30 moved relative to the webs and apply a combined pressure and heat impact so that the foil 1 and the glass fibre fabric are joint together in a lamination in a continuous movement.

When the relevant part of webs have been moved away of the rollers they are laminated and are forwarded in between two co-operating pressure surfaces 7, 8 that are 5 provided with cooling means.

The cooling means will over a time period of e.g. 0.1 seconds cool the composite to a temperature of about 50°C whilst under pressure.

10

The composite is finally wound up on the roll 10.

It is understood that many different types of apparatuses can be designed for the performance of the invention.

15

As an example thereof, it can be mentioned, that the corresponding pressure surface arrangement displayed in dotted lines could be omitted.

## PATENT CLAIMS:

1. A method of manufacture of a composite product comprising at least one layer of reinforced woven material and at least one layer of PTFE foil or ePTFE foil, where the foil or foils are laminated together with the layer or layers of woven material under the use of heating and pressurising,  
5 characterised in that the composite material subsequently is cooled to a fully or partly fixed state.
- 10 2. A method according to claim 1, characterised in that the cooling is carried out over a period of time of approximately 0.1 to 240 seconds from a temperature of 300 to 420 °C, preferably 20 to 120 seconds from a temperature of 380 to 400 °C to a temperature of about 50 °C.  
15
- 20 3. A method according to claim 1 or 2, characterised in that the composite material is subject to a tension during the cooling.
- 25 4. A method according to claims 1-3, characterised in that the composite material undergoes a combined cooling and pressure operation by means for pressure application.
- 30 5. A method according to claims 1-4, characterised in that the means for pressure supply is provided with cooling means.

6. A method according to claims 1-5, characterised in that the pressure supply is provided continuously by means for pressure supply comprising at least one roller.

5

7. A method according to claims 1-6, characterised in that the pressure supply is provided intermittently by means for pressure supply comprising a pressure surface.

10

8. A method according to claims 1-7, characterised in that the composite material is cooled under a substantively uniform pressure over the surface by a cooling surface.

15

9. A composite product manufactured according to the claims 1-8, characterised in that the product comprises at least one foil layer of PTFE or ePTFE foil and at least one layer of reinforcing woven material.

20

10. A composite product according to claim 9, characterised in that the reinforcing woven material consists at least partly of glass fibre fabric or PTFE coated glass fibre fabric.

25

11. An apparatus for manufacture of a composite material comprising at least one layer of reinforcing woven material and at least one layer of PTFE foil or ePTFE foil, where the foil or foils are laminated together with the layer or layers of woven material under the use of heating and pressurising, as the apparatus comprises means for lamination of the composite material by a combined pressure and heat supply,

characterised in that the apparatus further comprises means for fixation of the uncooled or at least only partly cooled composite material and with said means co-operating controllable cooling means.

5

12. An apparatus according to claim 11, characterised in that the means of the apparatus for fixation and the associated controllable cooling means comprises at least one pressure surface including  
10 integrated cooling means.

13. An apparatus according to claim 11, characterised in that the means of the apparatus for fixation and the associated controllable cooling  
15 means comprises at least one roller having integrated cooling means.

1/1

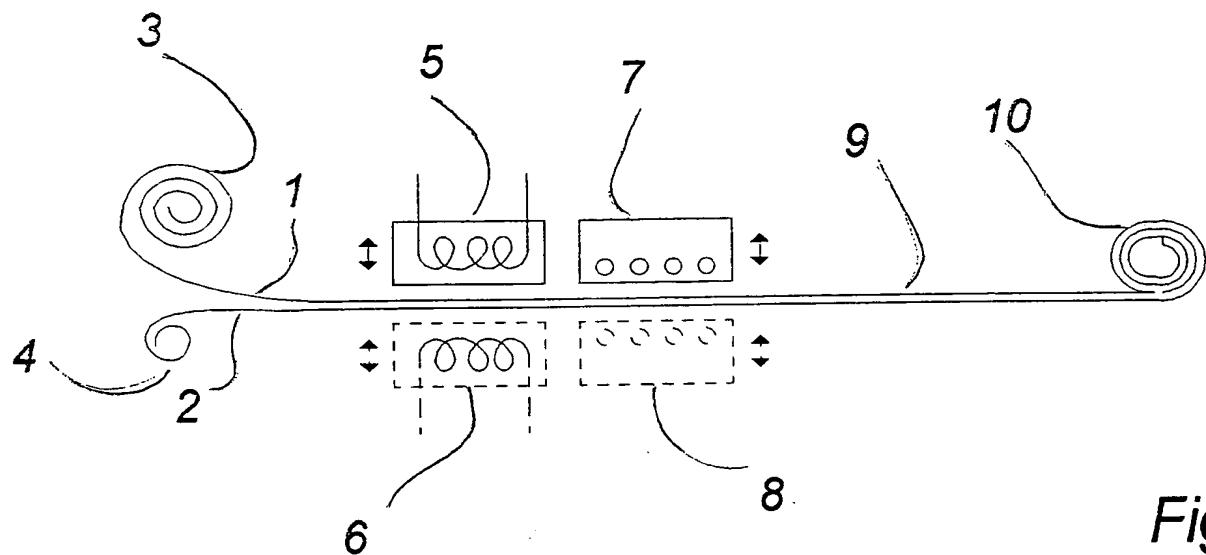


Fig. 1

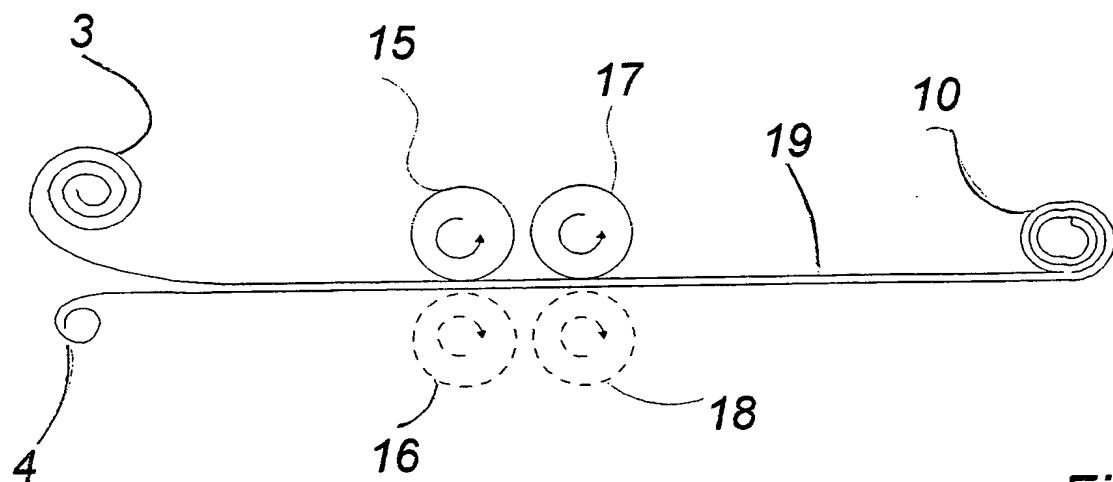


Fig. 2

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/DK 98/00342

## A. CLASSIFICATION OF SUBJECT MATTER

**IPC6: B32B 27/12, B32B 31/08, B29C 65/44**

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

**IPC6: B32B, B29C**

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

**SE,DK,FI,NO classes as above**

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## WPI

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9209429 A1 (CHEMFAB CORPORATION), 11 June 1992 (11.06.92), Example 1  --	1,3-13
X	EP 0711657 A2 (HOECHST AKTIENGESELLSCHAFT), 15 May 1996 (15.05.96), Example 1, claims 1-2  --	1,3-13
A	GB 1451824 A (BASF AKTIENGESELLSCHAFT), 6 October 1976 (06.10.76), page 1, line 64 - line 73; page 2, line 3 - line 5, figures 1 and 2  --	6,11,13

 Further documents are listed in the continuation of Box C. See patent family annex.

- \* Special categories of cited documents:
- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed
- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search

18 November 1998

Date of mailing of the international search report

18 -11- 1998

Name and mailing address of the ISA/  
Swedish Patent Office  
Box 5055, S-102 42 STOCKHOLM  
Facsimile No. + 46 8 666 02 86

Authorized officer  
**Monika Bohlin**  
Telephone No. + 46 8 782 25 00

## INTERNATIONAL SEARCH REPORT

International application No. PCT/DK 98/00342
--

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9008651 A1 (CHEMICAL FABRICS CORPORATION), 9 August 1990 (09.08.90), page 2, line 31 - page 3, line 32  --	1-13
A	EP 0159942 A2 (CHEMICAL FABRICS CORPORATION), 30 October 1985 (30.10.85), page 3, line 17 - line 31, Example 1, figure 1  -- -----	1-13

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

03/11/98

International application No. <b>PCT/DK 98/00342</b>	
---	--

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO	9209429 A1	11/06/92	AU    651163 B AU    9068191 A CA    2077998 A DE    69127436 D,T EP    0515621 A,B US    5357726 A	14/07/94 25/06/92 24/05/92 26/02/98 02/12/92 25/10/94
EP	0711657 A2	15/05/96	CA    2158805 A DE    4437004 A JP    8183140 A	16/04/96 18/04/96 16/07/96
GB	1451824 A	06/10/76	BE    812365 A DE    2312816 A,C FR    2221260 A,B JP    1261792 C JP    49128082 A JP    59034487 B NL    7403041 A	16/09/74 06/02/75 11/10/74 25/04/85 07/12/74 23/08/84 17/09/74
WO	9008651 A1	09/08/90	AU    5087390 A CA    2011205 A,C EP    0419594 A,B US    5141800 A US    5357726 A AT    150697 T DE    69030291 D,T	24/08/90 31/08/91 03/04/91 25/08/92 25/10/94 15/04/97 17/07/97
EP	0159942 A2	30/10/85	CA    1262676 A JP    1981767 C JP    6098736 B JP    61035245 A	07/11/89 25/10/95 07/12/94 19/02/86

E.K.

## PATENT COOPERATION TREATY

PCT

(8)

REC'D	29 OCT 1999
WIPO	PCT

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference  P 98 002 WO	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No.  PCT/DK98/00342	International filing date (day/month/year)  06/08/1998	Priority date (day/month/year)  06/08/1997
International Patent Classification (IPC) or national classification and IPC  B32B27/12		
Applicant  KE-BURGMANN A/S et al.		
<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 6 sheets, including this cover sheet.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of 16 sheets.</p>		
<p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> <li>I   <input checked="" type="checkbox"/> Basis of the report</li> <li>II   <input type="checkbox"/> Priority</li> <li>III   <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</li> <li>IV   <input type="checkbox"/> Lack of unity of invention</li> <li>V   <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</li> <li>VI   <input type="checkbox"/> Certain documents cited</li> <li>VII   <input checked="" type="checkbox"/> Certain defects in the international application</li> <li>VIII   <input checked="" type="checkbox"/> Certain observations on the international application</li> </ul>		

Date of submission of the demand  18/02/1999	Date of completion of this report  27.10.99
Name and mailing address of the international preliminary examining authority:   European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer  Giese, H-H  Telephone No. +49 89 2399 8488



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/DK98/00342

**I. Basis of the report**

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

**Description, pages:**

1-13                  as received on                  09/08/1999 with letter of                  06/08/1999

**Claims, No.:**

1-13                  as received on                  09/08/1999 with letter of                  06/08/1999

**Drawings, sheets:**

1                  as originally filed

2. The amendments have resulted in the cancellation of:

the description,        pages:  
 the claims,              Nos.:  
 the drawings,            sheets:

3.  This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/DK98/00342

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Yes:	Claims 1-13
	No:	Claims -
Inventive step (IS)	Yes:	Claims 2,13
	No:	Claims 1, 3-12
Industrial applicability (IA)	Yes:	Claims 1-13
	No:	Claims -

**2. Citations and explanations**

**see separate sheet**

**VII. Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:

**see separate sheet**

**VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

**see separate sheet**

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/DK98/00342

**Re Item V Reasoned statement under Article 35(2) with regard to novelty,  
inventive step or industrial applicability; citations and  
explanations supporting such statement**

1. The following document (D) is referred to in this communication:

D1: GB-A-1 451 824

2. Prior art does not teach the subject-matter of independent claims 1, 9 and 11. Thus they are regarded to be novel and to meet the requirements of Article 33(2) PCT.

None of the in the international search report cited prior art documents reveal an apparatus, a method or a composite in which means are involved for fixation of the not-cooled composite product before and especially during cooling for reducing shrinkage.

3. In the light of the disclosure in the prior art, the solution proposed by the present application cannot be regarded as involving an inventive step. Therefore, claims 1, 9 and 11 do not meet the requirements of Article 33(3) PCT.

- 3.1. The technical problem to be solved by the present invention was to improve form stability during manufacturing (page 3, lines 6-9).

- 3.2. In order to solve the posed problem, the skilled person would turn to closest prior art document D1 (column 1, line 34 to column 2, line 89; column 3, lines 3-5; examples; figures) where a method for cavity-free manufacturing of laminates is described. A semifinished product is produced from fibre-reinforced material and a textile web material under pressure at a temperature from 150-300 °C. To prevent shrinkage the hot laminate is cooled under pressure. The fibre-reinforced material is selected from the group of several olefin polymers and chlorine-containing polymers such as polyvinyl chloride, polyvinylidene chloride and chlorinated polyolefins and the textile web from

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/DK98/00342

glass fibers mats.

The only difference between closest prior art document D1 and the application is that the latter discloses polytetrafluoroethylene whereas D1 also mentions halogenated olefinic polymers but chlorinated olefines instead of fluorinated olefines. This difference appears to be merely a chemical alternative which provides similar advantages towards non-halogenated polymers. Consequently, "the invention consists merely in selecting a small number of chemical compounds from a broad field" (see the Guidelines C-IV, 8.8. C1)(iv) PCT).

- 3.3. Dependent claims 3-8, 10 and 12 do not appear to contain any additional feature which, in combination with the features of any claim to which it refers, meet the requirements of the PCT with respect to novelty and inventive step, because the described manufacturing procedure appears to be merely a well-known alternative producing method (see the Guidelines C-IV, 8.8. C1) PCT).
4. Prior art does not teach or suggest the subject-matter of dependent claims 2 and 13. Thus, they are regarded as to be novel and inventive according to Article 33(2)(3) PCT.
5. The claimed invention appears to be industrially applicable and therefore present application meets the requirements of Article 33(4) PCT.

**Re Item VII Certain defects in the international application (form or content)**

1. As required by Rule 5.1(a)(ii) PCT, it is appropriate to not merely identify documents D1 to D4 (see page 3, lines 5-7) but also to discuss the relevant background art disclosed therein briefly (see also the Guidelines C-II, 4.4 PCT).
2. As required by Rule 5.1(a)(ii) PCT prior art should not merely be disclosed in the introductory part of the description on pages 1 to 3, but the document(s) should be identified in the description of the background art.

INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET

International application No. PCT/DK98/00342

Re Item VIII Certain observations on the international application (clarity)

1. The application does not meet the requirements of Article 6 PCT, because claims 1, 10 and 11 are not clear. The term "partly" renders the scope of the invention unclear, since it is not apparent at the moment
  - to what extend the composite material is "fully or **partly fixed**" during cooling (claim 1);
  - to what extend the composite product is made from "partly" glass fibre fabric (see claim 10: "**partly ... consist**"). Moreover, the term "consist" means in general patent English that the woven material is **exclusively** composed of glass fibre fabric.
  - at what temperature the composite should be when fixed by fixation means (claim 11: "uncooled or at least only **partly cooled** composite material", see also page 4, lines 16-19, page 5, last paragraph).
2. The application does not meet the requirements of Article 6 PCT, because claim 2 is not clear. The wording "from a temperature of 300 to 420 °C, preferably 20 to 120 seconds from a temperature of 380 to 400 °C to a temperature of about 50 °C" renders the scope of the invention unclear, since it is not apparent at the moment which temperature should be achieved after the period of time. For examining reasons the passage on page 5, 2nd and 3rd paragraph are referred to in this communication for issuing an opinion about novelty and inventive step of this claim.
3. The words "about" and "approximately" in relation to numerical values render claim 2 and the corresponding passages in the description (e.g. page 5, 2nd and 3rd paragraph; page 11, line 18; page 13, line 8) unclear (Article 6 PCT, Guidelines C-III, 4.5a PCT).

**PCT****REQUEST**

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only	
International Application No. PCT/DK 98 / 00342	
06 AUGUST 1998	
Patentdirektoratet	
Danish Patent Office	
PCT-International Application	
Name of receiving Office and "PCT International Application"	
Applicant's or agent's file reference (if desired) (12 characters maximum)	

**Box No. I TITLE OF INVENTION**

Method of manufacturing a composite material

**Box No. II APPLICANT**

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

KE-Burgmann A/S  
Expansion Joints Division  
Parkallé 34  
6600 Vejen  
Denmark

This person is also inventor.

Telephone No.

Facsimile No.

Teleprinter No.

State (that is, country) of nationality:

Danish

State (that is, country) of residence:

Danish

This person is applicant  all designated  all designated States except  the United States of America  the United States of America only  the States indicated in the Supplemental Box

**Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)**

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

Mathiesen, Benny Martin  
G1. Strandvej 1  
5500 Middelfart  
Denmark

This person is:

 applicant only applicant and inventor inventor only (If this check-box is marked, do not fill in below.)State (that is, country) of nationality:  
DanishState (that is, country) of residence:  
Danish

This person is applicant  all designated  all designated States except  the United States of America  the United States of America only  the States indicated in the Supplemental Box

Further applicants and/or (further) inventors are indicated on a continuation sheet.

**Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE**

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)  
R&D Manager  
Mathiesen, Benny Martin  
KE-Burgmann A/S  
Expansion Joints Division  
Parkallé 34  
6600 Vejen, Denmark

Telephone No.

+45 7536 1811

Facsimile No.

+45 7536 1532

Teleprinter No.

Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

**Box No.V DESIGNATION OF STATES**

The following designations are hereby made under Rule 4.9(a) (mark the applicable check-boxes; at least one must be marked):

**Regional Patent**

- AP ARIPO Patent:** GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, SD Sudan, SZ Swaziland, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- EA Eurasian Patent:** AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- EP European Patent:** AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- OA OAPI Patent:** BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT (if other kind of protection or treatment desired, specify on dotted line)

**National Patent (if other kind of protection or treatment desired, specify on dotted line):**

- |  |  |
|--|--|
| <input checked="" type="checkbox"/> AL Albania .....                               | <input checked="" type="checkbox"/> LS Lesotho .....                                   |
| <input checked="" type="checkbox"/> AM Armenia .....                               | <input checked="" type="checkbox"/> LT Lithuania .....                                 |
| <input checked="" type="checkbox"/> AT Austria .....                               | <input checked="" type="checkbox"/> LU Luxembourg .....                                |
| <input checked="" type="checkbox"/> AU Australia .....                             | <input checked="" type="checkbox"/> LV Latvia .....                                    |
| <input checked="" type="checkbox"/> AZ Azerbaijan .....                            | <input checked="" type="checkbox"/> MD Republic of Moldova .....                       |
| <input checked="" type="checkbox"/> BA Bosnia and Herzegovina .....                | <input checked="" type="checkbox"/> MG Madagascar .....                                |
| <input checked="" type="checkbox"/> BB Barbados .....                              | <input checked="" type="checkbox"/> MK The former Yugoslav Republic of Macedonia ..... |
| <input checked="" type="checkbox"/> BG Bulgaria .....                              | <input checked="" type="checkbox"/> MN Mongolia .....                                  |
| <input checked="" type="checkbox"/> BR Brazil .....                                | <input checked="" type="checkbox"/> MW Malawi .....                                    |
| <input checked="" type="checkbox"/> BY Belarus .....                               | <input checked="" type="checkbox"/> MX Mexico .....                                    |
| <input checked="" type="checkbox"/> CA Canada .....                                | <input checked="" type="checkbox"/> NO Norway .....                                    |
| <input checked="" type="checkbox"/> CH and LI Switzerland and Liechtenstein .....  | <input checked="" type="checkbox"/> NZ New Zealand .....                               |
| <input checked="" type="checkbox"/> CN China .....                                 | <input checked="" type="checkbox"/> PL Poland .....                                    |
| <input checked="" type="checkbox"/> CU Cuba .....                                  | <input checked="" type="checkbox"/> PT Portugal .....                                  |
| <input checked="" type="checkbox"/> CZ Czech Republic and utility model .....      | <input checked="" type="checkbox"/> RO Romania .....                                   |
| <input checked="" type="checkbox"/> DE Germany and utility model .....             | <input checked="" type="checkbox"/> RU Russian Federation .....                        |
| <input checked="" type="checkbox"/> DK Denmark and utility model .....             | <input checked="" type="checkbox"/> SD Sudan .....                                     |
| <input checked="" type="checkbox"/> EE Estonia .....                               | <input checked="" type="checkbox"/> SE Sweden .....                                    |
| <input checked="" type="checkbox"/> ES Spain and utility model .....               | <input checked="" type="checkbox"/> SG Singapore .....                                 |
| <input checked="" type="checkbox"/> FI Finland and utility model .....             | <input checked="" type="checkbox"/> SI Slovenia .....                                  |
| <input checked="" type="checkbox"/> GB United Kingdom .....                        | <input checked="" type="checkbox"/> SK Slovakia and utility model .....                |
| <input checked="" type="checkbox"/> GE Georgia .....                               | <input checked="" type="checkbox"/> SL Sierra Leone .....                              |
| <input checked="" type="checkbox"/> GH Ghana .....                                 | <input checked="" type="checkbox"/> TJ Tajikistan .....                                |
| <input checked="" type="checkbox"/> GM Gambia .....                                | <input checked="" type="checkbox"/> TM Turkmenistan .....                              |
| <input checked="" type="checkbox"/> GW Guinea-Bissau .....                         | <input checked="" type="checkbox"/> TR Turkey .....                                    |
| <input checked="" type="checkbox"/> HR Croatia .....                               | <input checked="" type="checkbox"/> TT Trinidad and Tobago .....                       |
| <input checked="" type="checkbox"/> HU Hungary .....                               | <input checked="" type="checkbox"/> UA Ukraine .....                                   |
| <input checked="" type="checkbox"/> ID Indonesia .....                             | <input checked="" type="checkbox"/> UG Uganda .....                                    |
| <input checked="" type="checkbox"/> IL Israel .....                                | <input checked="" type="checkbox"/> US United States of America .....                  |
| <input checked="" type="checkbox"/> IS Iceland .....                               | <input checked="" type="checkbox"/> UZ Uzbekistan .....                                |
| <input checked="" type="checkbox"/> JP Japan .....                                 | <input checked="" type="checkbox"/> VN Viet Nam .....                                  |
| <input checked="" type="checkbox"/> KE Kenya .....                                 | <input checked="" type="checkbox"/> YU Yugoslavia .....                                |
| <input checked="" type="checkbox"/> KG Kyrgyzstan .....                            | <input checked="" type="checkbox"/> ZW Zimbabwe .....                                  |
| <input checked="" type="checkbox"/> KP Democratic People's Republic of Korea ..... |  |
| <input checked="" type="checkbox"/> KR Republic of Korea .....                     |  |
| <input checked="" type="checkbox"/> KZ Kazakhstan .....                            |  |
| <input checked="" type="checkbox"/> LC Saint Lucia .....                           |  |
| <input checked="" type="checkbox"/> LK Sri Lanka .....                             |  |
| <input checked="" type="checkbox"/> LR Liberia .....                               |  |

Check-boxes reserved for designating States (for the purposes of a national patent) which have become party to the PCT after issuance of this sheet:

- .....
- .....

**Precautionary Designation Statement:** In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. (Confirmation of a designation consists of the filing of a notice specifying that designation and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.)

RO/DK

3 OCT 1998

PCT/DK 98/00342

Sheet No. 3.....

RO/DK 15 SEP 1998

R9/DK

**Box No. VI PRIORITY CLAIM** Further priority claims are indicated in the Supplemental Box.

Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is:		
		national application: country	regional application: regional Office	international application: receiving Office
item (1) 06.08.97	0910/97	Denmark (DK)		
item (2)				
item (3)				

The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) (only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office) identified above as item(s): (1)

\* Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.

**Box No. VII INTERNATIONAL SEARCHING AUTHORITY**

**Choice of International Searching Authority (ISA)**  
(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):

ISA /SE

**Request to use results of earlier search; reference to that search (if an earlier search has been carried out by or requested from the International Searching Authority):**

Date (day/month/year)

Number

Country (or regional Office)

**Box No. VIII CHECK LIST; LANGUAGE OF FILING**

This international application contains the following number of sheets:

request	:	3
description (excluding sequence listing part)	:	12
claims	:	3
abstract	:	1
drawings	:	1
sequence listing part of description	:	

Total number of sheets : 19

This international application is accompanied by the item(s) marked below:

- fee calculation sheet
- separate signed power of attorney
- copy of general power of attorney; reference number, if any:
- statement explaining lack of signature
- priority document(s) identified in Box No. VI as item(s):
- translation of international application into (language):
- separate indications concerning deposited microorganism or other biological material
- nucleotide and/or amino acid sequence listing in computer readable form
- other (specify):

Figure of the drawings which should accompany the abstract: 1

Language of filing of the international application: Danish

**Box No. IX SIGNATURE OF APPLICANT OR AGENT**

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

Benny Mathiesen, R&amp;D Manager

**KE-BURGMANN A/S**  
PARK ALLÉ 34  
DK-6600 VEJEN  
TEL. +45 75 36 18 11

For receiving Office use only

1. Date of actual receipt of the purported international application:

RO/DK 06 AUG 1998 (06.08.98)

2. Drawings:

 received:

3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:

4. Date of timely receipt of the required corrections under PCT Article 11(2):

5. International Searching Authority (if two or more are competent): ISA / SE

6.  Transmittal of search copy delayed until search fee is paid. not received:

For International Bureau use only

Date of receipt of the record copy by the International Bureau:

19 AUG 1998

See Notes to the request form

**Fremgangsmåde til fremstilling af et komposit materiale****Teknikkens baggrund**

Opfindelsen angår en fremgangsmåde til fremstilling af et komposit materiale som angivet i krav 1's indledende del, 5 et komposit produkt i krav 9's indledende del samt et apparat til udøvelse af fremgangsmåden ifølge krav 11's indledning.

10 Komposit produkter omfattende et forstærkende vævsmateriale og et PTFE - folie anvendes til meget forskellige industriformål. Indenfor den kemiske industri anvendes materialet således til eksempelvis kar, 15 kompensatorer, beholdere, transportbånd og kemiske barrierer generelt, der skal kunne modstå kraftige kemiske og temperaturmæssige påvirkninger. Dette gælder ligeledes inden for kraftværk, fødevareindustrien samt mange andre anvendelser, hvor der ligeledes lægges vægt 20 på pålidelige og stærke mekaniske og/eller kemiske egenskaber.

I et kompositmateriale af den ovenstående type vil de i kompositten indgående materialer tilsammen give de egenskaber, der gør kompositten egnet til en given 25 anvendelse. Typisk vil vævsmaterialet tilføre forbedrede mekaniske egenskaber under temperaturbelastning, mens det eller de indgående PTFE-folier vil tilvejebringe barriere-egenskaber, der kan opretholdes under relativt høje temperaturer.

30 Imidlertid har det vist sig at være vanskeligt at opnå et fornuftigt "samspil" mellem de i kompositten indgående komponenter under fremstillingen af kompositten, da et kompositprodukt typisk vil krympe relativt meget under fremstilling, således at det endelige slutkompositprodukt har væsentligt forskellige dimensioner 35

end det oprindelige ikke laminerede produkt. Dette er særligt et problem i forbindelse med fremstilling af kompositprodukter med fastlagte ønskede dimensioner, ligesom det må konstateres, at kompositproduktet særligt 5 i randområdetne har tendens til at bøje eller krølle.

Udover at det i sig selv er et problem at kompositten krymper, hvadenten det drejer sig om en formindskelse eller forlængelse, er det ligeledes et problem, at det 10 kan være vanskeligt at forudse hvilke dimensioner slutproduktet egentligt opnår. Dette medfører typisk, at kompositten, hvor det er muligt, skal bearbejdes yderligere efter lamineringen. Denne yderligere forarbejdelse giver dels anledning til materialespild, 15 ligesom det som oftest ikke er muligt at foretage den videre forarbejdning af et produkt automatiseret.

Yderligere skal det anføres, at materialespildet som 20 resultat af materialets krympning i sig selv er så højt, at det spiller en væsentlig faktor i den endelige produktionspris. En sammenlamineret komposit af den ovennævnte type kan krympe mere end 10%.

En måde at forbedre fremstillingsprocessen er at tilføre 25 vævsmaterialet et ekstra lag coating på den modsatte side af de pålaminerede PTFE-folier.

Denne løsning er imidlertid fordyrende for fremstillingsprocessen i sig selv, medfører et større 30 materialeforbrug, og medfører endeligt, at de færdige kompositmaterialer bliver forøgede i tykkelse og vægt.

#### **Opfindelsens baggrund**

Ved, som angivet i krav 1, at afkøle kompositmaterialet 35 efterfølgende helt eller delvist i en fikseret tilstand,

opnås et kompositmateriale med en større formstabilitet, reduceret krympning og et forøget E-modul.

Ved at nedsætte krympningen for det i kompositten  
5 indgående PTFE, opnås dermed en bedre formstabilitet for det samlede produkt, da vævsmateriale typisk er meget følsomt overfor krympning ved laminering med et folie.

Det overordnede formål, dvs. at opnå en forbedret  
10 formstabilitet, er således en meget væsentlig faktor i forbindelse med en præcisionsudførelse af kompositkomponenter, rørgennemføringer, kompensatorer, transportbånd, tankliners, beholdere eller lignende  
15 anvendelser, hvor en manglende formstabilitet medfører, at det færdige produkt krymper med en relativ stor, men ikke helt fastlagt, procentdel.

Dette gælder eksempelvis også, hvor kompositmaterialer i eksempelvis et kemisk anlæg skal kombineres med  
20 formstabile komponenter med kendte dimensioner, idet det kan være særdeles svært at "gætte" dimensionerne på det færdige kompositprodukt.

En fiksering af kompositten kan eksempelvis foretages ved  
25 at udspænde denne i en ramme, og efterfølgende foretage en afkøling ved hjælp af en luftart eller en væske.

I forbindelse med opfindelsen foretrækkes det at lade  
afkølingen foregå så hurtigt som muligt efter  
30 opvarmningen.

Med et forstærkende vævsmateriale forstås eksempelvis  
glasvæv, PTFE-væv, PTFE coated glasvæv eller andre  
tilsvarende materialer. Det foretrækkes dog i mange  
35 anvendelser at anvende glasvæv. Med et ePTFE-folie  
forstås et eksanderet PTFE-folie.

Det er ifølge opfindelsen, ved at fiksere kompositten helt eller delvist under afkøling, ligeledes muligt at styre eller kontrollere krympningen af det færdige produkt, hvilket er meget væsentligt i forbindelse med produkter, der stiller store krav til dimensionerne af slutproduktet. En del af afkølingsforløbet kan eksempelvis foretages i fikseret tilstand, mens en anden del af afkølingsforløbet kan foretages i ikke-fikseret tilstand.

Det er underforstået, at opfindelsen kan udøves som en delproces af en samlet proces, idet det er muligt at fremstille et kompositmateriale med ét adderet lag folie og væv af gangen, således at et flerlags kompositmateriale kan fremstilles ved at laminere ét lag til kompositten af gangen.

Derudover opnås den væsentlige fordel, at det færdige kompositmateriale i sig selv ifølge opfindelsen har undergået en væsentlig mindre formindskelse af slutproduktet i forhold til de tilførte folier og vævsarealer, hvorfor "udnyttelsesgraden" kan forøges med op til mindst 10%.

Derudover undgås en kraftig beskæring af randområderne, hvorfor materialespildet i denne forbindelse reduceres.

Ved, som angivet i krav 2, at lade afkølingen foretages over en tidsperiode på tilnærmelsesvis 0,1 - 240 sekunder fra en temperatur på 300-420 °C til en temperatur på tilnærmelsesvis 50 °C, opnås en fordelagtig og praktiske udførelsesform ifølge opfindelsen.

Det foretrækkes for flere anvendte materialetykkelser, at tidsperioden er på tilnærmelsesvis 20 - 120 sekunder fra

en temperatur på 380-400 °C til en temperatur på tilnærmelses 50 °C.

Det er underforstået, at tids- og afkølingsforløbet  
5 afhænger meget af tykkelse og egenskaber af de indgående komponenter.

Det skal dog understreges, at afkølingen kan foretages ret hurtigt, hvorfor den kombinerede afkøling og  
10 fiksering er meget attraktiv i forbindelse med automatiserede og kontinuerlige fremstillingsprocesser.

Det er ligefrem underforstået, at der kan opnås forbedrede resultater ved at udøve en afkøling ifølge opfindelsen over et deltemperaturinterval, ligesom det er underforstået, at det bedste resultat dog oftest vil opnås ved afkøling over hele temperaturintervallet, dvs. fra en given høj temperatur, til en ønsket sluttemperatur.  
20

Ved, som angivet i krav 3, at lade kompositmaterialet udsættes for et træk under afkølingen, opnås fordelagtig udførelsesform ifølge opfindelsen

25 Ved, som angivet i krav 4, at udsætte kompositmaterialet for en kombineret afkøling og trykpåvirkning af midler til trykpåvirkning, opnås er særlig fordelagtig udførelsesform ifølge opfindelsen, idet midlerne til trykpåvirkning fikserer kompositmaterialet under afkølingen, hvilket medfører en stærkt forbedret formstabilitet. Helt specifikt kan der opnås et særdeles højt E-modul for det endelige kompositprodukt, ligesom der kan opnås en god formstabilitet. Dette medfører eksempelvis, at krympning af et kompositmateriale fremstillet ifølge opfindelsen vil være kraftigt reduceret. I visse produkttyper vil krympningen kunne  
30  
35

reduceres med en faktor 10-15 ligesom E-modulet kan forøges med en faktor 5.

Den opnåede fiksering ved hjælp af midler til trykpåvirkning medfører ligeledes, at kompositten kan afkøles under et meget højt tryk, idet kompositten således bliver fikseret kontrolleret under hele afkølingen. Dette høje afkølingstryk medfører dels, at komposittens form bliver fastholdt under afkøling til sin endelige tilstand, og dels at afkølingen foregå langt hurtigere over fladen. En forbedret kontakt mellem midler til trykpåvirkning og kompositten medfører således en forbedret indbyrdes varmetransport, hvorved afkølingen af kompositten kan accelereres.

Ved, som angivet i krav 5, at udforme midlerne til trykpåvirkning med kølemidler, opnås en særlig fordelagtig udførelsesform ifølge opfindelsen, idet det har vist sig, at denne kombinerede afkøling og trykpåvirkning giver et optimalt resultat i forhold de fremstillede kompositmaterialer. Dels opnås således et produkt med forbedrede krympningsegenskaber, ligesom produktet kan fremstilles under en relativ ukompliceret styring.

Som anført ovenstående vil en forbedret kontakt mellem midler til trykpåvirkning og kompositten således medføre en forbedret indbyrdes varmetransport, hvorved afkølingen af kompositten kan accelereres.

Ved, som angivet i krav 6, at udøve trykpåvirkningen kontinuerligt ved hjælp af midler til trykpåvirkning i form af mindst én valse, opnås en økonomisk fordelagtig mulighed for at foretage en kontinuerlig produktion af et formstabilit kompositmateriale og/eller et højt E-modul.

Fremstillingen kan ligeledes fortages i et relativt højt tempo.

Ved, som angivet i krav 7, at udøve trykpåvirkningen  
5 stepvist ved hjælp af midler til trykpåvirkning i form af en trykflade, opnås en særlig fordelagtig udførelsesform ifølge opfindelsen, idet en trykpåvirkning udøvet ved hjælp af en trykflade for det første kan kontrolleres fuldstændigt i den forstand, at supplerende træk i folier  
10 eller komposittens fladeretning i flere anvendelser kan undgås helt.

Trykpåvirkningen kan således udøves ved styring af kun én parameter, dvs. trykket udøvet af midlerne til  
15 trykpåvirkning. Ved at anvende denne trykflade undgås således, at diffusionsegenskaberne påvirkes ukontrolleret ved samtidig trækpåvirkning i folier eller komposit.

Med en trykflade forstås i denne forbindelse eksempelvis  
20 en decideret flade, ligesom en trykflade kan udgøres af en form.

Det foretrækkes ifølge opfindelsen at anvende relativt høje fladetryk, da fiksering under afkølingen således  
25 bliver bedre. Der kan eksempelvis anvendes fladetryk på 0.1 - 20 N/mm<sup>2</sup>.

Et højt fladetryk på kompositmaterialet under afkølingen vil således give forbedrede materialeegenskaber både med  
30 hensyn til formstabilitet og performance, ligesom krympningen i komposittens fremføringsretning i den kontinuerlige proces nedsættes, da kompositten som resultat af anvendelse af en trykflade også fastholdes i dennes længderetning under afkølingen.

Ved, som angivet i krav 8, at afkøle kompositmaterialet under et i hovedsagen uniformt tryk over fladen ved hjælp af en afkølingsflade, opnås mulighed for at opnå et kompositmateriale, hvis krympningsegenskaber er ens over hele fladen.

Ved, som angivet i krav 9, at lade produktet omfatte mindst ét folielag af PTFE eller ePTFE-folie, samt mindst et lag forstærkende væv, opnås et produkt med et højt E-modul og i øvrigt fordelagtige materialeegenskaber.

En yderligere fordel ved et komposit produkt af den ovenstående art er, at randegenskaberne bliver væsentligt forbedret, da en nedsat krympning af specielt materialer, der består af eksempelvis et lag PTFE-folie sammenlamineret uden udnyttelse af opfindelsens lære, har tendens til at "krølle op" i randen af kompositproduktet. Den ulempe bliver dels opvejet ved at krympningsegenskaberne bliver bedre, dvs. mindre krympning, ligesom fiksering af kompositten under afkølingen forbedrer den resulterende formstabilitet overalt i produkter, og dermed randsektionen.

Ved, som angivet i krav 10, at lade det forstærkende væv udgøres helt eller delvist af glasvæv eller PTFE-coated glasvæv, opnås en særlig fordelagtig udførelsesform ifølge opfindelsen, idet opfindelsen har vist sig særlig fordelagtig i forbindelse med glasvævs relativt store føjelighed i forhold til et sammenlamineret PTFE-folie. Det har således vist sig, at det er muligt at fremstille komposit produkter, dvs. diskrete komponenter, endeløse baner af kompositten etc., uden at dimensionerne af det endelige produkt afviger væsentligt fra den oprindelige form af kompositten i dens ikke-endelige tilstand.

Under alle omstændigheder er det ifølge opfindelsen muligt at få en større grad af forudsigelighed med hensyn til krympning.

5   **Figuren**

Opfindelsen vil i det følgende blive beskrevet under henvisning til tegningen, hvor

10   fig. 1 viser en foretrukken udførelsesform ifølge opfindelsen, og hvor

fig. 2 viser en yderligere udførelsesform ifølge opfindelsen.

15   **Udførelseseksemplet**

På fig. 1 ses en principskitse af en foretrukken automatiseret udførelsesform ifølge opfindelsen.

20   Det viste apparat bliver i den viste udførelsesform fødet af endeløse baner af PTFE-folie 1 og PTFE coated glasvæv 2 fra en rulle PTFE-folie 3 og en rulle PTFE-coated glasvæv 4. Den færdige komposit 9 er oprullet på en rulle 10.

25   Ifølge den viste udførelsesform udfører banerne 1 og 2 en relativ bevægelse i forhold til apparatet og rullerne 3, 4 og 10 roteres ved hjælp af ikke viste midler fremføringsmidler i en stepvis bevægelse ind mellem to samvirkende opvarmningstrykflader 5 og 6. Disse trykflader 5, 6 er i den viste udførelsesform forbundet med ikke viste hydrauliske tryk- og bevægelsesmidler og er indrettet til at foretage en relativ bevægelse til og fra de to baner 1 og 2.

35   Den ovennævnte stepvise bevægelse svarer i hovedsagen til trykfladerne 5, 6 i længderetningen.

Når den stepvise bevægelse har ført to nye dellængder af foliet 1 og glasvævet 2 ind mellem trykfladerne 5, 6 vil trykfladerne bevæge sig mod banerne og udøve en kombineret tryk- og varmepåvirkning, således at foliet 1 og glasvævet sammenlaminerer.

Ifølge den viste udførelsesform opvarmes foliet og glasvævet til en temperatur på ca. 380°C - 400°C under et tryk på 0.1-20 N/mm<sup>2</sup>.

Når lamineringen er fuldendt vil trykfladerne 5, 6 bevæges fra hinanden og den nu sammenlaminerede komposit vil i en stepbevægelse fremføres ind mellem to samvirkende trykflader 7, 8, der er udformet med kølemidler.

Kølemidlerne vil over en tidsperiode på 20-120 sekunder afkøle kompositten til en temperatur på omkring 50°C og et tryk på 0.1-20 N/mm<sup>2</sup>.

Når lamineringen af dellængden er fuldendt vil trykfladerne 5 og 6 bevæges fra hinanden og kompositten vil blive oprullet på rullen 10.

Det er underforstået, at den ovenfor beskrevne proces er en kontinuerlig proces, hvor en afkøling af en dellængde foretages sideløbende med opvarmningen af en foregående dellængde.

Det er ligeledes underforstået, at de forskellige procesparametre kan justeres og optimeres til de valgte materialers egenskaber og tykkelse.

Det vil således være indenfor opfindelsens rammer at variere på temperatur og tidsintervaller under

hensyntagen til de anvendte materialer og det ønskede færdige resultat.

Det er ligeledes underforstået, at kompositten også kan 5 påføres flere laminat- og glasvævslag indtil den ønskede tykkelse og de ønskede materialeegenskaber er opnået.

På fig. 2 ses en yderligere udførelsesform ifølge opfindelsen.

10 I den viste udførelsesform bliver apparatet fødet af endeløse baner af PTFE-folie 1 og PTFE coated glasvæv 2 fra en rulle PTFE-folie 3 og en rulle PTFE-coated glasvæv 4. Den færdige komposit 9 er oprullet på en rulle 10.

15 Ifølge den viste udførelsesform udfører banerne 1 og 2 en relativ bevægelse i forhold til apparatet og rullerne 3, 4 og 10 roteres ved hjælp af ikke viste midler fremføringsmidler i en kontinuerlig bevægelse ind mellem 20 to samvirkende opvarmningstrykflader i form af valser 15 og 16. Disse valser 15, 16 er i den viste udførelsesform forbundet med ikke viste trykmidler.

25 Når den kontinuerlige bevægelse har ført to nye dellængder af foliet 1 og glasvævet 2 ind mellem trykvalserne 15, 16 vil trykfladerne bevæge sig mod banerne og udøve en kombineret tryk- og varmepåvirkning, således at foliet 1 og glasvævet sammenlamineret i en kontinuerlig bevægelse.

30 Når banerne er bevæget væk fra valserne, ville disse være sammenlamineret og fremføres ind mellem to samvirkende trykflader 7, 8, der er udformet med kølemedier.

Kølemidlerne vil over en tidsperiode på eksempelvis 0.1 sekund afkøle kompositten til en temperatur på omkring 50°C under tryk.

- 5 Kompositten vil afslutningsvis blive oprullet på rullen 10.

Det er underforstået, at der kan designes mange forskellige typer apparater til udøvelse af opfindelsen.

- 10 Eksempelvis kan nævnes, at det stipede korresponderende trykfladearrangement kan udelades.

**K R A V**

1. Fremgangsmåde til fremstilling af et komposit produkt  
5 omfattende mindst ét lag forstærkende vævsmateriale samt mindst ét lag PTFE-folie eller ePTFE-folie, idet foliet eller folierne sammenlamineres med laget eller lagene af vævsmateriale under opvarmning og tryk
- 10 k e n d e t e g n e t v e d, at kompositmaterialet efterfølgende afkøles helt eller delvist i en fikseret tilstand.
- 15 2. Fremgangsmåde ifølge krav 1, k e n d e t e g n e t v e d, at afkølingen foretages over en tidsperiode på tilnærmelses 0,1 - 240 sekunder fra en temperatur på 300-420 °C, fortrinsvis 20 - 120 sekunder fra en temperatur på 380-400 °C, til en temperatur på tilnærmelses 50 °C.
- 20 3. Fremgangsmåde ifølge krav 1 eller 2, k e n d e t e g - n e t v e d, at kompositmaterialet udsættes for et træk under afkølingen
- 25 4. Fremgangsmåde ifølge krav 1-3, k e n d e t e g n e t v e d, at kompositmaterialet udsættes for en kombineret afkøling og trykpåvirkning af midler til trykpåvirkning.
- 30 5. Fremgangsmåde ifølge krav 1-4, k e n d e t e g n e t v e d, at midlerne til trykpåvirkning er udformet med kølémidler.
6. Fremgangsmåde ifølge krav 1-5, k e n d e t e g n e t v e d, at trykpåvirkningen udøves kontinuerligt ved hjælp af midler til trykpåvirkning i form af mindst én valse.

7. Fremgangsmåde ifølge krav 1-6, kendtegnet ved, at trykpåvirkningen udøves stepvist ved hjælp af midler til trykpåvirkning i form af en trykflade.
- 5 8. Fremgangsmåde ifølge krav 1-7, kendtegnet ved, at afkøle kompositmaterialet under et i hovedsagen uniformt tryk over fladen ved hjælp af en afkølingsflade.
- 10 9. Komposit produkt fremstillet i henhold til kravene 1-8, kendtegnet ved, at produktet omfatter mindst ét folielag af PTFE eller ePTFE-folie, samt mindst et lag forstærkende væv.
- 15 10. Komposit produkt ifølge krav 9, kendtegnet ved, at det forstærkende væv udgøres helt eller delvist af glasvæv eller PTFE-coated glasvæv.
- 20 11. Apparat til fremstilling af et komposit materiale omfattende mindst ét lag forstærkende vævsmateriale samt mindst ét lag PTFE-folie eller ePTFE-folie, idet foliet eller folierne sammenlamineres med laget eller lagene af glasvæv under opvarmning og tryk, idet apparatet omfatter midler til sammenlaminering af kompositmaterialet under en kombineret tryk- og varmepåvirkning,
- 25 kendtegnet ved, at apparatet yderligere omfatter midler til fiksering af det uafkølede eller kun delvist afkølede kompositmateriale og med disse midler samvirkende styrbare kølemidler.
- 30 12. Apparat ifølge krav 11, kendtegnet ved, at apparatets midler til fiksering og samvirkende styrbare kølemidler omfatter mindst én trykflade med integrerede kølemidler.

13. Apparat ifølge krav 11, kendtegnet ved, at apparatets midler til fiksering og samvirkende styrbare kølemidler omfatter mindst én valse med integrerede kølemidler.

**SAMMENDRAG**

- Opfindelsen angår en fremgangsmåde til fremstilling af et komposit produkt omfattende mindst ét lag forstærkende vævsmateriale samt mindst ét lag PTFE-folie eller ePTFE-folie, idet foliet eller folierne sammenlamineres med laget eller lagene af glasvæv under opvarmning og tryk, idet kompositmaterialet efterfølgende afkøles helt eller delvist i en fikseret tilstand.
- Ifølge en foretrukken udførelsesform, fikseres kompositten ved hjælp af en eller to samvirkende trykflader under et relativt højt tryk.
- Ifølge opfindelsen opnås et formstabilit kompositmateriale med et stærkt forøget E-modul.

(Fig. 1)

1/1

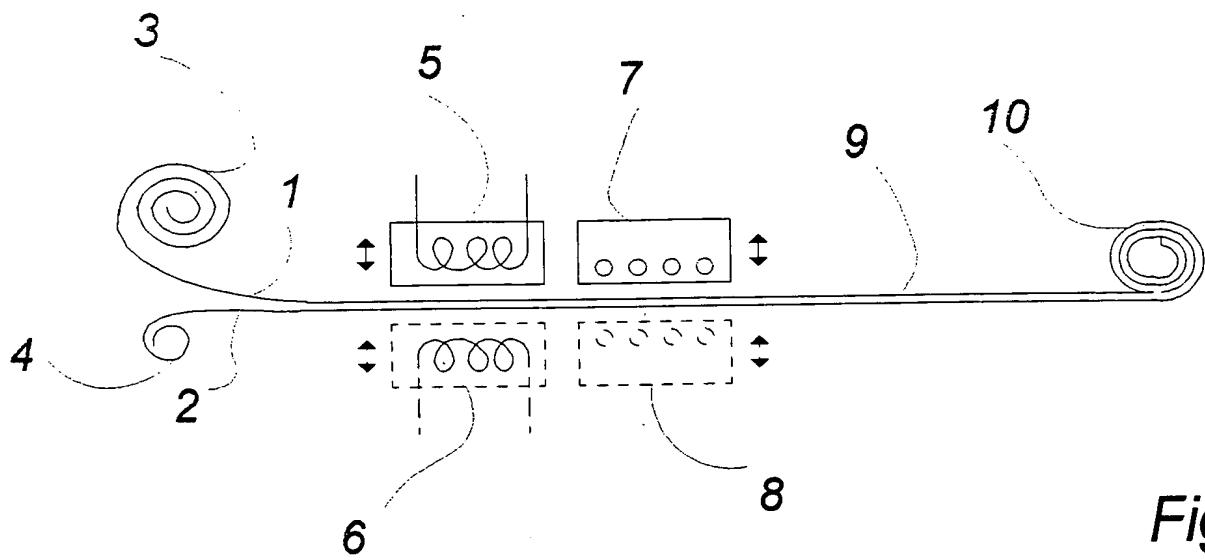


Fig. 1

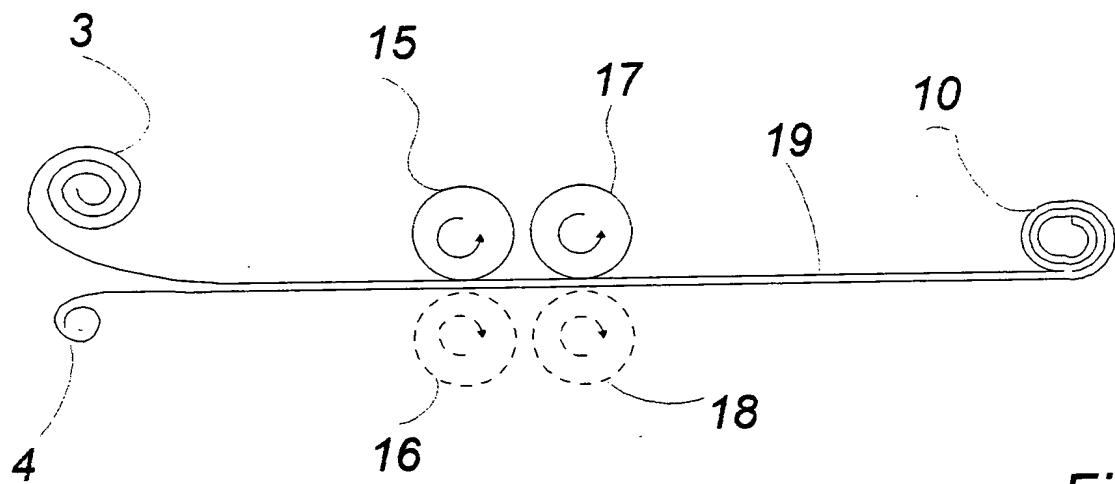


Fig. 2